



## Clinical Evaluation of Metal Free Pressable Glass Ceramic Crowns on Anterior Teeth – An Invivo study

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### ABSTRACT

**Background:** Restorative materials used in cosmetic zone should fulfil esthetic and functional demands of the patients. Increasing esthetic demands by the patients have prompted the clinicians to use more and more nonmetallic restorative materials for the fabrication of anterior crowns. This study was undertaken to assess the clinical performance of crowns made with pressable lithium di-silicate glass ceramic materials IPS e max (Ivoclar Vivadent).

**Methodology:** 78 patients restored with 100 lithium disilicate pressable glass ceramic crowns (IPS Emax Ivoclar Vivadent) on anterior teeth were studied. They were clinically evaluated at base line, after one month, three months, six months and nine months. They are evaluated for retention, fracture resistance, marginal integrity, gingival health, esthetics and secondary caries.

**Results:** At the end of nine months, out of 89 crowns available for the study 3 crowns needed replacement making overall failure rate of 3.37

**Conclusion:** Lithium disilicate pressable glass ceramic crowns are the best alternative for restoration of anterior teeth with high esthetic demands due to their various advantages and excellent clinical performance and they are recommended as one of the treatment modality for restoration of anterior teeth in cases of high aesthetic demands.

### KEYWORDS

lithium disilicate glass ceramic crowns, metal free ceramics, clinical evaluation of anterior crowns

### Introduction

Restorative materials used in cosmetic zone should fulfill esthetic and functional demands of the patients. It should be strong, structurally durable, and lifelike and have predictable survival rate<sup>1</sup>. Increasing esthetic demands by the patients have prompted the clinicians to use more and more non-metallic restorative materials for the fabrication of anterior crowns. Dental ceramics are proved to be more effective and suitable alternative to metals for this purpose. Ceramic materials have desirable properties such as biocompatibility, color stability, low thermal conductivity and excellent translucency comparable to natural tooth structure. Because of these favorable characteristics and demand for its use more and more researches have been carried out in metal free ceramic restorations<sup>2</sup>. Although lots of in-vitro studies have been carried out in this field, in vivo studies on its clinical performance have been sparse in the literature. This study was undertaken to assess the clinical performance of crowns made with pressable lithium di-silicate glass ceramic materials IPS e max (Ivoclar Vivadent).

### Materials and Method

An experimental population, which consisted of 78 patients (48 men and 30 women) who needed restoration of teeth with full coverage restoration (Fig-1a) for a variety of reasons, was selected for the study. The treatment plans for the 78 patients that involved maxillary and mandibular anterior teeth resulted in 100 crowns (Fig -1b). Patients were selected and recruited based on the following inclusion criteria: extensive loss of tooth structure indicating full veneer crown, or crowns needing replacement (i.e., marginal discrepancy, secondary caries, fracture,

and esthetics), periodontal pocket depth < 3mm, and no history of previous periodontal flap surgeries, good oral hygiene and low caries activity.

Patient who had history of drug abuse, or life threatening diseases, radiotherapy in head and neck region, severe intermaxillary skeletal discrepancy, excessive para-functional activity leading to wear of prosthetic teeth or fracture of dentures, and those who were heavy smokers were excluded from this study.

For each crown, shade was determined prior to tooth preparation. For the preparations, a circumferential shoulder with rounded internal line angles at a depth of 1.0 to 1.3 mm was created with rotary diamond burs to ensure maximum retention and resistance form. The incisal reduction was 1.5 mm and palatal area was reduced by 0.8 mm. Finally all the sharp edges and angles were rounded. After tooth preparation, margins were finished with fine diamond burs. The smoothness of the finish lines and ability to transfer the details to the stone die is essential for the precision and fit of the crown. The maxillary anterior region and palatal concavity was accurately determined to provide anatomic anterior disocclusion.

The margins were located at the level of gingival crest or slightly into the sulcus depending upon the esthetic demands. Gingival displacement was obtained using retraction cord. Following removal of the retraction cord, poly vinyl siloxane impression of the prepared teeth were made and poured with type IV stone. The coping design of 0.6 mm thickness was made using residue free tooth colored wax and coping was fabricated by pressing the ceramic ingot as per the manufacturers' instructions. The coping was checked on the individual die and required corrections were made to receive veneering porcelain. The assessed shade of porcelain was built-up and baked. The necessary finishing protocols were carried out and crowns were bonded on to the tooth structure by using dual cured composite resin. Before bonding, inner surface of the crowns were etched with hydrofluoric acid and rinsed thoroughly with water and air dried. Tooth surface was etched with 37% phosphoric acid thoroughly rinsed and dried. Sialane coupling agent was applied onto the inner surface of the crowns and air dried. Bonding agent provided along with the dual cure adhesive resin cement was applied on the tooth surface and light cured. Required amount of adhesive resin



**Figure 1a,b. Representative sample of the patient showing discolored maxillary anterior teeth restored using pressable glass ceramic crowns**

cement was mixed on mixing pad and crowns were luted and wave cured for 3 sec. Excess of cement was taken out and final curing was done for 40 seconds from each side. Excessive cement was removed using carbide carvers and crown was finished using micro-fine and superfine flexible silicone polishers and universal polishing paste. Each crown was evaluated two days after cementation (base line) and at the end of one month, three months, six months and nine months. Clinical examination included the use of mouth mirror, sharp explorer and William's periodontal probe. Kaplan – Meier statistics were used to analyze the survival rates obtained for the crowns. Partial or complete debonding, fracture of ceramic/ copings, and impaired esthetics, marginal deficiency, and secondary caries were the main criteria for the irreparable failure.

**Results**

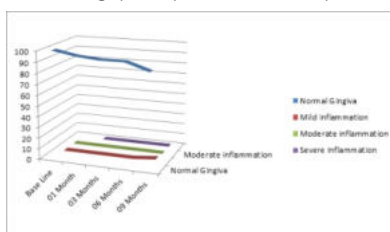
At the end of nine months 89 crowns were available for evaluation, out of which 1 crown failed due to poor retention (1.12%), 1 crown failed due to fracture of the restoration (1.12%), and one crown failed due to marginal deficiency (1.12%). All the failed cases were restored with new IPS emax all ceramic crowns.

At the end of nine months, out of 89 crowns available for the study 3 crowns needed replacement making overall failure rate of 3.37%. Mild marginal deficiency without penetration by explorer was seen in relation to 2 teeth (2.24%). Mild gingivitis was seen in 2 patients (2.24%) and 2 crowns (2.24%) showed variations in shade which was acceptable to the patients. Table 1 shows data on failure of crowns due to poor retention, fractured restorations, & marginal integrity of the restoration and Graph 1 shows recall data on gingival health.

**Table – 1: Recall Data on Retention, Fracture of Restoration & Marginal Integrity**

Time of Evaluation	Retention			Kaplan–Meier Survival Estimate	Fracture of Restoration			Kaplan–Meier Survival Estimate	Marginal Integrity			Kaplan–Meier Survival Estimate
	A	B	C		D	E	F		G	H	I	
Base line	100	0	0	1	100	0	0	1	98	2	0	1
1 Month	100	0	0	1	100	0	0	1	7.98	2.0	0	1
3 Months	100	0	0	1	100	0	0	1	97.87	2.1	0	1
6 Months	100	0	0	0	0	0	0	1	97.82	2.1	0	1
9 Months	98.88	0	1.12	0.98	98.88	0	1.12	0.98	96.63	2.25	1.12	0.98

**A-** Crown stable with no movement, **B-**Crown stable with light movement, **C-** Crown debonded from abutment,**D-** No fracture, **E-** Fracture of the veneering porcelain without involving the coping, **F-** Through and through fracture involving veneering porcelain and coping,**G-** No visible evidence of gap along the margin and no catch and penetration of the explorer, **H-** Visible evidence of gap, catch with an explorer but no penetration, **I-** Variable evidence of gap and penetration of explorer



**Graph 1: Recall data on Gingival Health**

**Discussion**

Current research trend is to develop ceramic system that does not have metallic sub structure, structurally strong and have optical properties similar to natural teeth<sup>3</sup>. High strength lithium disilicate based pressable glass ceramic IPS e max (Ivoclar Vivadent) has most of the desirable characteristics. Glass matrix consists of micron sized lithium disilicate crystals between which are sub micron lithium ortho- phosphate crystals<sup>4</sup>. Porcelain consisting of fluorapatite crystals in aluminosilicate glass was used to veneer the copings. Recent study reported that IPS e max press ceramic showed higher resistance to crack formation and thus making it more reliable for crowns placed in stress bearing areas. In-vitro studies have shown that fracture resistance of IPS e max crowns is comparable to the fracture resistance of the natural unprepared teeth<sup>5</sup>. The inherent limitations of these in-vitro studies are well known, so the present study was planned as a prospective clinical trial. The purpose of this investigation was to assess the clinical performance of crowns made with pressable glass ceramic materials. Reports on clinical trial of all ceramic crowns provide some information about success and failures. This study demonstrated survival rates of 98.88% for retention, and fracture resistance over a period of nine months. This is comparable with the study by Masquardt and Strub<sup>6</sup> in which a total of 27 out of thirty lithium disilicate crowns were rated satisfactory for the variable observation period. Similar results were found in the studies by Taskonak and Sertgoz<sup>7</sup>, Zimmer ET al<sup>8</sup> and Gelmamz and Ergin<sup>9</sup>.

Fracture of the crowns in our study may be attributed to excessive functional stresses, external line angle of tooth preparation and reduced thickness of the coping. Therefore teeth preparation, fabrication and adjustment of coping form critical steps in prosthetic treatment involving lithium disilicate crowns.

Failures due to debonding of the crowns were seen in 1.12 % of cases. This failure can be attributed to poor bonding with adhesive resin cements and micro-leakage. Micro-leakage is an important factor for the clinical longevity of the fixed restorations. Hybrid layer formation plays an important role in bonding process by improving ability of the adhesive material in preventing micro leakage. Another interface related to cementation procedure is the resin cement ceramic interface. IPS e max is silica based ceramic with high crystalline content (60 % by volume). A strong resin bond relays on micromechanical and chemical bonding to the ceramic surface which requires roughening and cleaning for surface activation. In vitro Studies indicate that acid etching with hydrofluoric acid to roughen the ceramic surface along with the application of sialane coupling agent provide a most durable bonding between crown and cement. The clinical success of the resin cemented ceramic restoration depends on the quality and durability of bond between ceramic and the tooth.

After nine months of the observation period mild gingivitis was seen in two patients. This may be attributed to the poor oral hygiene of the patients. 2 (2.25%) crowns showed variations in shade acceptable to the patients. This may be attributed to the inappropriate shade matching by the clinician and inadequate communication between the clinician and the dental technicians.

**Summary and Conclusion**

Conventional PFM Crowns for restoration of anterior teeth have their own limitations. All ceramic crowns are increasingly preferred by the clinicians and patients for esthetic restorations of anterior teeth. Lithium disilicate pressable glass ceramic crowns are preferred due to their various advantages and excellent clinical performance. So they are strongly recommended as one of the treatment modality for restoration of anterior teeth.

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